## ANDERSON GREENWOOD TANK BLANKETING REGULATORS

Part of a complete system that incorporates a pilot operated, dome-loaded diaphragm type regulator capable of reducing blanketing gas in a single step, providing bubble-tight shut-off and low maintenance.

### FEATURES

- Single unit system lowers installation costs, reducing labor and materials.
- Simple blanket pressure setting with one unit to calibrate as opposed to conventional multi-unit systems.
- Reduced maintenance costs as top entry provides access to all internal parts without removal from the line.
- Optimum performance reduces supply gas pressure from 200 psig (13.8 barg) to ½" wc (1.2 mbarg) in one stage.
- Balanced design maintains setting accurately regardless of pressure variations.
- O-ring seat and seals assure bubble-tight shut-off.
- Single-source solution provides pad and de-pad valves, regulators, pressure/vacuum vents and low pressure pilot operated valves, emergency vents and valves, flame and detonation flame arresters.
- Combined de-pad and pressure relief valve functions minimizes number of valves and tank connections.
- Component compatibility enables the provision of all major system components in a single tank penetration.

### GENERAL APPLICATION

The Tank Blanketing System provides a single-source solution to prevent evaporation, reduce fugitive emissions and corrosion, reduce or eliminate combustion potential, prevent contamination or oxidation and provide make-up when the pressure drops in the tank.

### TECHNICAL DATA

| | |
|---|---|
| Connections: | ½", 1", 2" NPT and flanged ANSI 150, 300, 600 |
| Temperature range: | -20 to +300°F (-29 to +149°C) |
| Maximum inlet pressure: | 200 psig (14 barg) |
| Blanket pressure range: | 0.5" wc to 6 psig (12.7 mm wc to 0.4 barg) |

## THE NEED FOR EFFECTIVE TANK BLANKETING OR PADDING

Blanketing is a process used to maintain a gas blanket or pad in the vapor space of a pressure-tight liquid storage vessel.

It normally involves the use of a valve or regulator to control the input of the pad gas, usually an inert gas such as nitrogen. When the pressure drops in the tank, the pad or blanketing valve will open and feed gas and pressure into the vessel, limiting the minimum pressure in the tank. This drop in pressure is normally caused by pump out or thermal cooling. In the event of pressure rise in the tank due to heat input or pump in, the de-pad or vent valve will open and vent pressure or pad gas from the tank.

Traditionally, this function was performed by a conservation vent or breather valve.
Today, because of the need to collect the gas coming off the top of the tank and prevent the pressure from increasing to a point where the vent valves will leak to atmosphere, a de-pad valve is set to open at a point below the vent valves. Because this valve normally discharges to a closed system, it must be balanced against back pressure.

## THE COMPLETE SYSTEM

Because of the interactions between pad (blanketing) valves, de-pad (out breathing) valves, relief devices and flame arresters, each piece of equipment should be considered when specifying the blanketing system and it makes sense to rely on one company to help specify and provide all of the products.

The Tank Blanketing System combines the use of a pilot operated blanketing valve and a pilot operated de-pad valve to provide a simple, reliable and accurate solution.
By using a modulating de-pad or vent valve, you can eliminate the need for traditional weight loaded, unbalanced vent valves, reducing project and maintenance costs, conserving blanket gas and further protecting the environment.

**Installation flexibility**
Depending on your systems needs, the Tank Blanketing System has the flexibility to be installed so that the pad valve, de-pad valve and vacuum breaker can be installed on a single nozzle (Figure 1) or multiple nozzles (Figure 2).

Internal sensing can also be provided in the same tank connection.

**Pad valves**

BV-1 (flanged)

Type Y1

Type RA

**De-pad valves**

Type 93

Type 9300

FIGURE 1

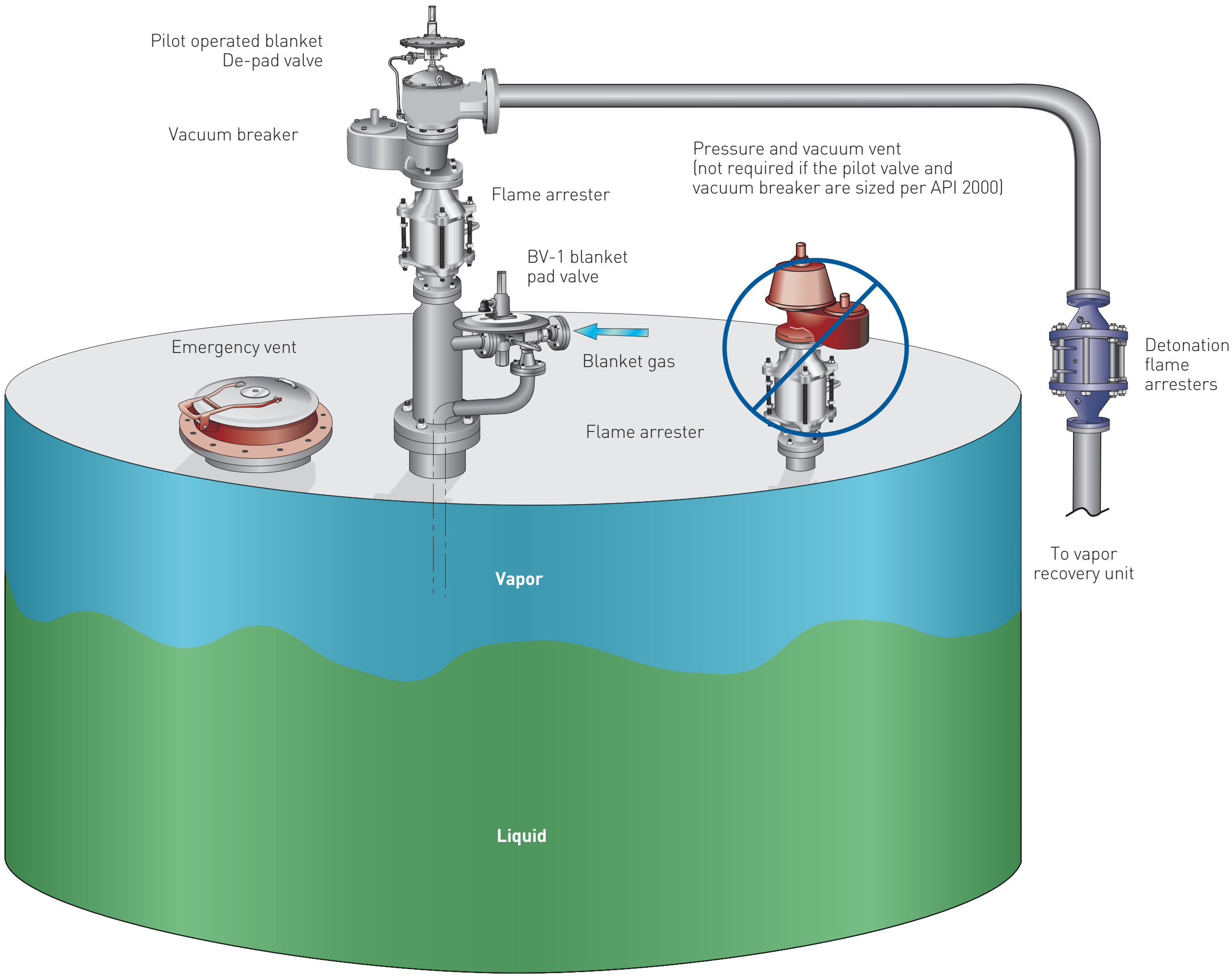
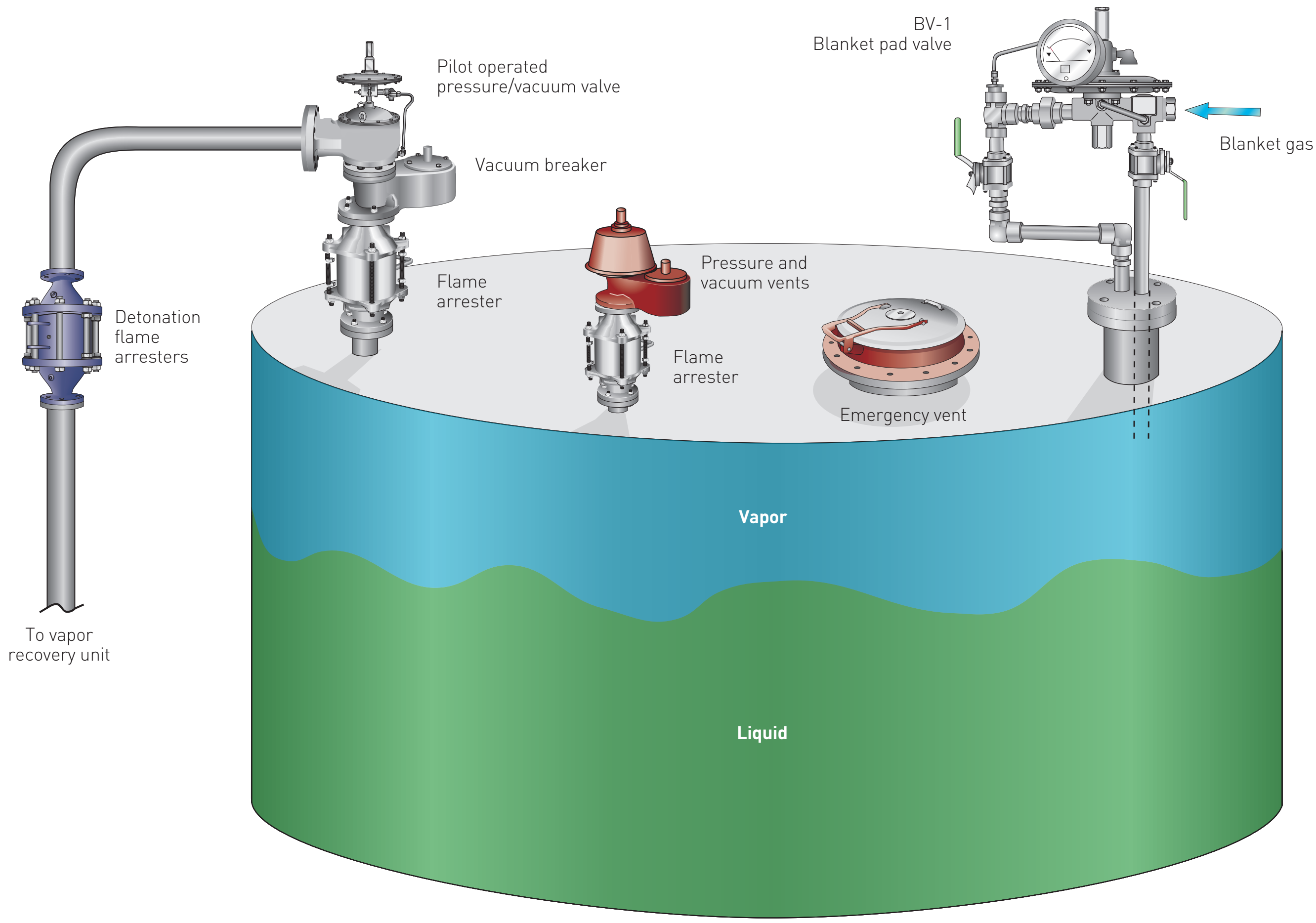

Pilot operated blanket
De-pad valve
Vacuum breaker
Flame arrester
BV-1 blanket
pad valve
Pressure and vacuum vent
(not required if the pilot valve and
vacuum breaker are sized per API 2000)
Emergency vent
Blanket gas
Flame arrester
Detonation
flame
arresters
To vapor
recovery unit
Vapor
Liquid

FIGURE 2


Pilot operated
pressure/vacuum valve
Vacuum breaker
BV-1
Blanket pad valve
Blanket gas
Flame
arrester
Pressure and
vacuum vents
Detonation
flame
arresters
Flame
arrester
Emergency vent
Vapor
Liquid
To vapor
recovery unit

## SINGLE VALVE SOLUTION

The conventional method (Figure 1) employs as many as four regulators to reduce high supply pressure to low blanket pressures, while the Anderson Greenwood system (Figure 2) requires only one unit to achieve the necessary reduction.

The Type Y1 pilot is used with the main valve to form a pressure reducing valve capable of regulating tank pressures from ½" wc to 6 psig (1.2 mbarg to 0.41 barg).

**Type RA direct spring operation**
For small flow requirements, the pilot alone can be used as a direct spring tank blanketing valve. The only difference in construction is the location of the sense and inlet ports. The sensed pressure acting against the spring force will determine if the pilot is to open and by how much.

**Type Y1 Y-style operation**
Upstream pressure enters the main body and acts upward against the main valve diaphragm. Due to a small unbalanced dome area, the effective area above the diaphragm is slightly larger than below. Shut-off will occur when the dome pressure is equal to the inlet pressure. The sleeve/diaphragm retainer assembly is lightly spring loaded to provide initial closing force when there is no pressure differential across the diaphragm.

The Type Y1 pilot controls dome pressure in response to tank pressure. A reduction in dome pressure allows the sleeve to move upward off the main seat, permitting flow through the valve. The amount of lift depends on the pressure reduction in the dome: the greater this reduction, the greater the flow.

When the downstream pressure is satisfied, the sensed pressure acting on the pilot sense plate will overcome the spring force to close the pilot, which in turn closes the valve. No system fluid is vented to the atmosphere.

**Type BV-1 right-angle style operation**
The diaphragm and sleeve are replaced by a piston in the main valve for more rugged construction. As with the Y1 valve, the pilot controls dome pressure. A reduction in dome pressure allows the piston to move horizontally off the seat, permitting flow through the valve. Maximum flow is controlled by the cage orifices.

**Conventional method**

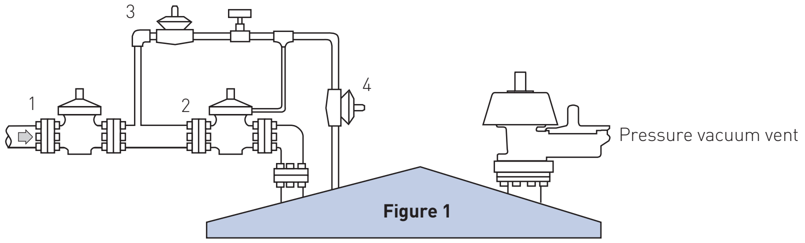



**Figure 1**

**Anderson Greenwood method**

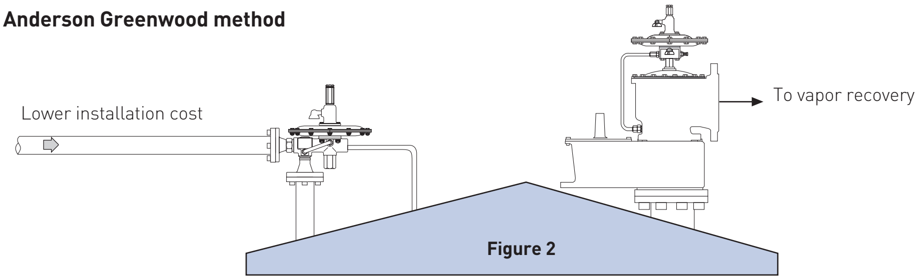
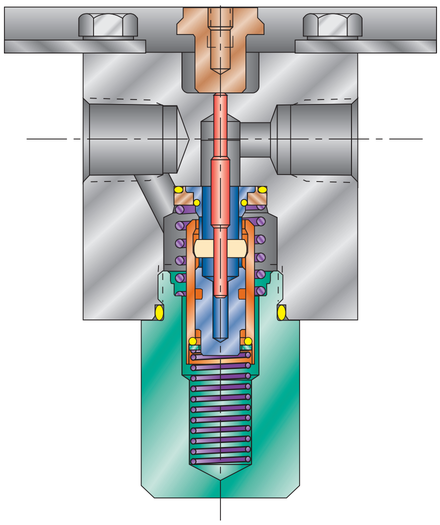
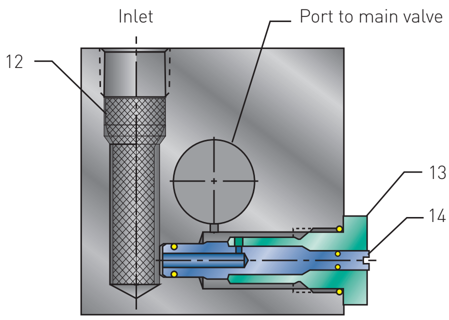
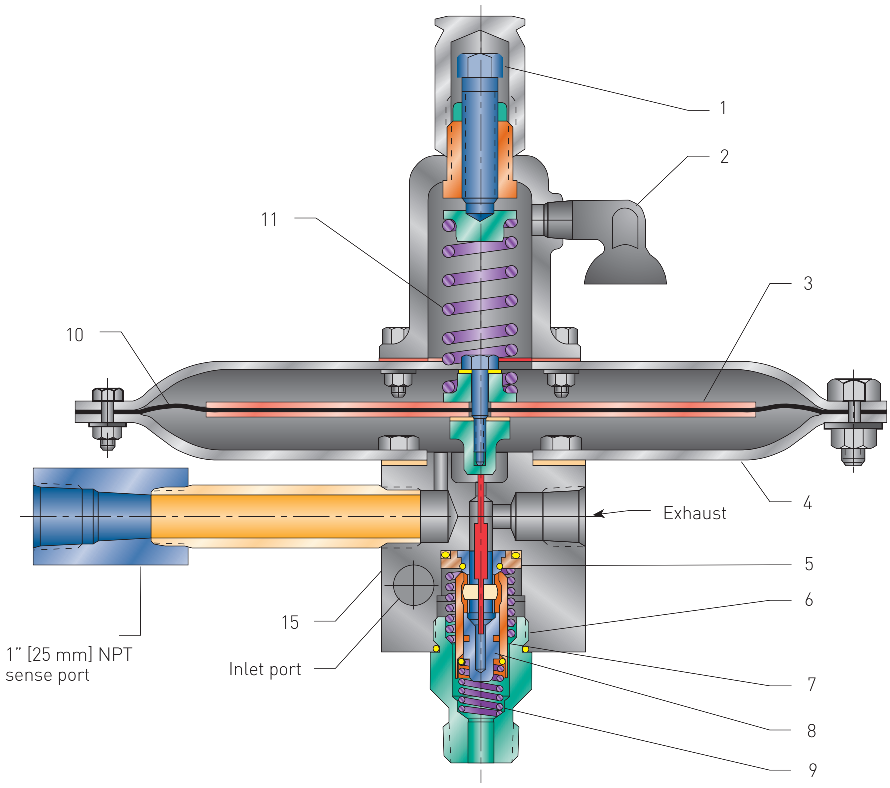



**Figure 2**



Type RA



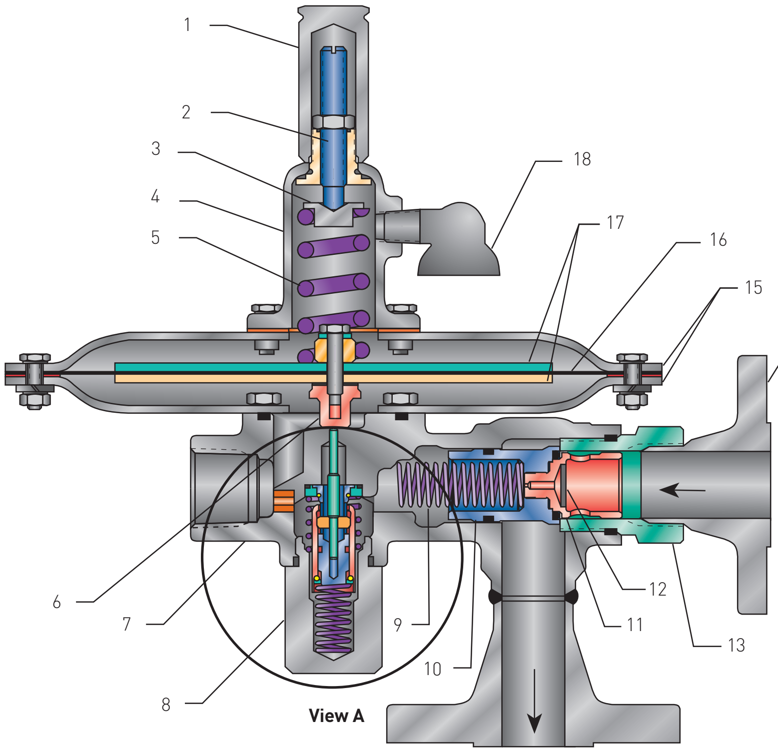

**Type Y1 pilot for 2" valve**

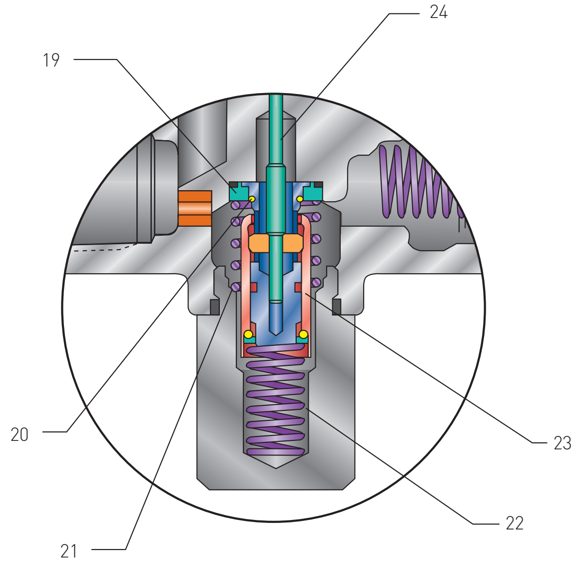
## PARTS AND MATERIALS

| No. | Part name | CS | SS |
|---|---|---|---|
| 1 | Set pressure adjustment screw | SS 304/CS | SS 304/316 |
| 2 | Vent | Zytel | Zytel |
| 3 | Sense plate | CS 1010/ZNCO | SS 302/304 |
| 4 | Case | CS A36 | SS 304 |
| 5 | Seat and seals | NBR[1] | NBR[1] |
| 6 | Sleeve | SS A479-316 | SS A479-316 |
| 7 | Sleeve seal | NBR[1] | NBR[1] |
| 8 | Nozzle - pilot | SS A479-316 | SS A479-316 |
| 9 | Sleeve spring | SS 316 | SS 316 |
| 10 | Diaphragm | NBR[2] | NBR[2] |
| 11 | Set pressure spring | SS 316 | SS 316 |
| 12 | Filter screen | SS 302 | SS 302 |
| 13 | Orifice retainer | SS A479-316 | SS A479-316 |
| 14 | Adjustable orifice core | SS A276-316 | SS A276-316 |
| 15 | Body | CS A108 1018 | SS A479 316 |

**NOTES**

1. NBR standard, FKM, EPR, Kalrez® optional.
2. NBR standard, FKM, EPR, PTFE optional.



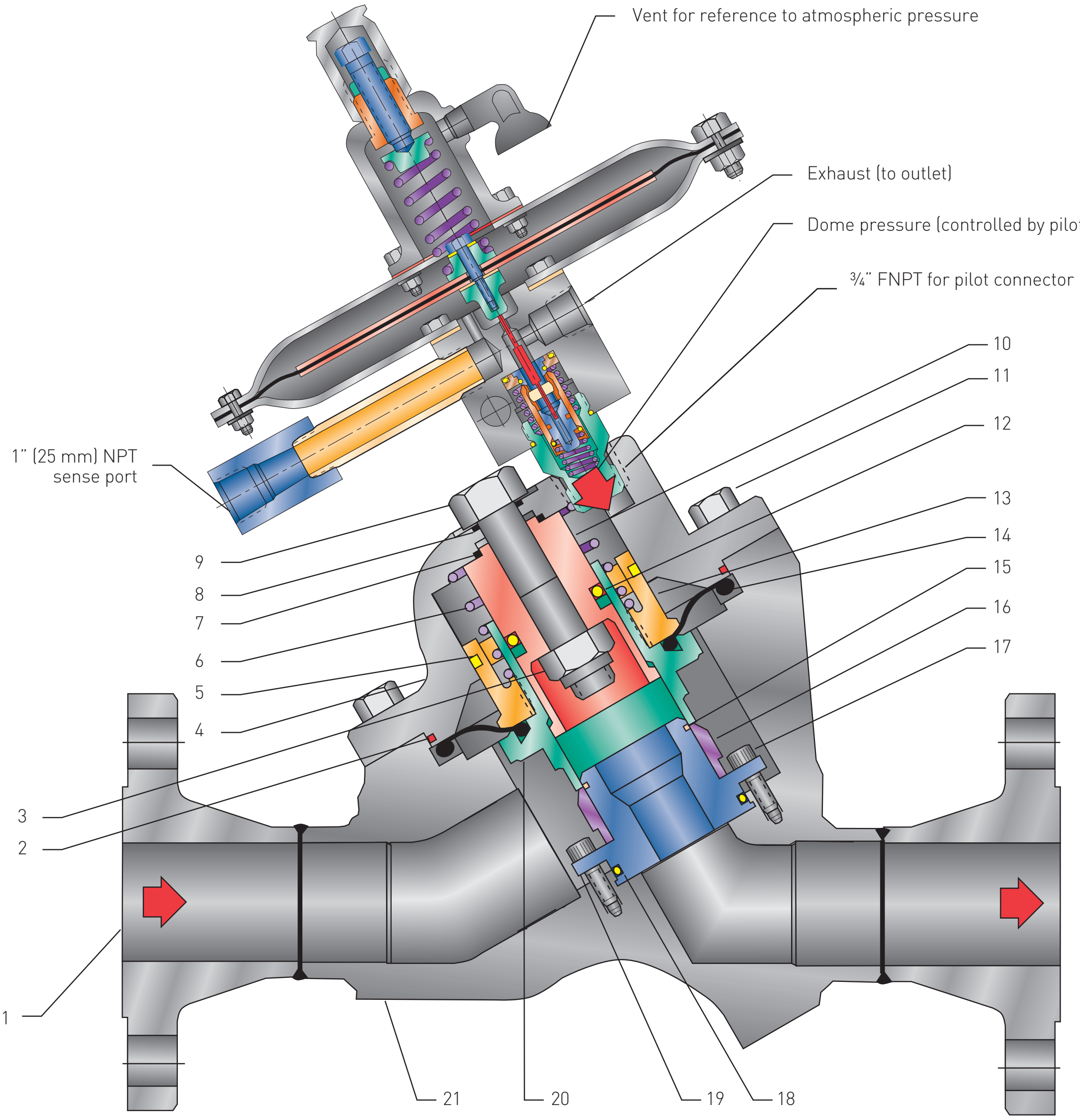

**MATERIALS OF CONSTRUCTION**

| No. | Part name | CS | SS |
|---|---|---|---|
| 1 | Pilot cap | SS A582-303 | SS A582-303 |
| 2 | Pressure adj. screw | SS A276-304 | SS A276-304 |
| 3 | Spring washer | STL A108-1213 | SS A479-316 |
| 4 | Bonnet assembly | SS SA351-CF8M | SS SA351-CF8M |
| 5 | Spring | SS 316 | SS 316 |
| 6 | Actuator | STL 12L14/ZNCO | SS A479-316 |
| 7 | Body | SS SA351-CF8M/SA105 | SS CF8M, SA-182-316 |
| 8 | Body plug | STL SA108-1018/ZNCO | SS A479-316 |
| 9 | Piston spring | SS 316 | SS 316 |
| 10 | Piston | SS A479-316 | SS A479-316 |
| 11 | Seat retainer/flow cage | SS A479-316 | SS A479-316 |
| 12 | Screen filter | SS 316 | SS 316 |
| 13 | Bushing nozzle | SS A479-316 | SS A479-316 |
| 14 | Inlet flange | STL SA105 | SS SA182-316 |
| 15 | Case | STL A36 | SS A240-304 |
| 16 | Diaphragm | PTFE | PTFE |
| 17 | Sense plate | STL 1010 | SS 302/304 |
| 18 | Vent | Zytel | Zytel |
| 19 | Nozzle retainer | SS A479-316 | SS A479-316 |
| 20 | Pilot seat | Fluorosilicone[1] | Fluorosilicone[1] |
| 21 | Nozzle retainer spring | SS 316 | SS 316 |
| 22 | Pilot sleeve spring | SS 302 | SS 302 |
| 23 | Pilot sleeve | SS A479-316 | SS A479-316 |
| 24 | Spindle | SS A276-316 | SS A276-316 |

**NOTE**

1. Fluorosilicone standard, NBR, EPR, Kalrez® optional.

## TYPE Y1 MAIN VALVE MATERIALS OF CONSTRUCTION



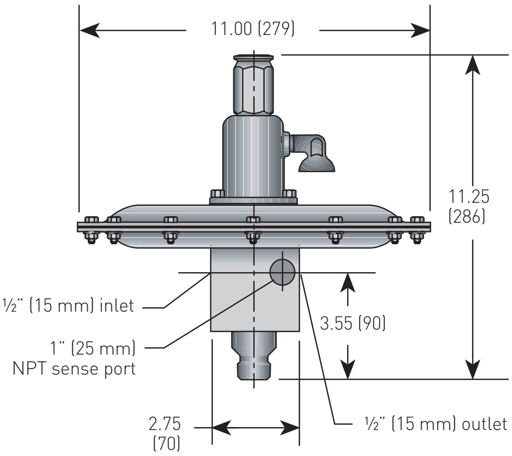

### MAIN VALVE

| No | Part name | CS | SS |
|---|---|---|---|
| 1 | Flange | Steel A105 | SS 182-316 |
| 2 | Cap seal | NBR[1] | NBR[1] |
| 3 | Lock nut | Alloy steel | SS 18-8 |
| 4 | Cap | Steel A216-WCB | SS A351-CF8M |
| 5 | Ring | SS 316 | SS 316 |
| 6 | Spring | SS 316 | SS 316 |
| 7 | Piston seal | NBR[1] | NBR[1] |
| 8 | Seal piston bolt | NBR[1] | NBR[1] |
| 9 | Piston bolt | Alloy steel | SS 18-8 |
| 10 | Piston | SS 303 | SS A479-316 |
| 11 | Cap bolt | Alloy steel | SS 18-8 |
| 12 | Sleeve seal | NBR[1] | NBR[1] |
| 13 | Diaphragm retainer | Steel 1213 | SS A479-316 |
| 14 | Diaphragm | NBR[1] | NBR[1] |
| 15 | Seat | NBR[1] | NBR[1] |
| 16 | Seat retainer | SS 316 | SS 316 |
| 17 | Nozzle screw | SS 18-8 | SS 18-8 |
| 18 | Nozzle seal | NBR[1] | NBR[1] |
| 19 | Nozzle | SS 316 | SS 316 |
| 20 | Sleeve | Steel A31-8620[2] | SS A479-316[2] |
| 21 | Body | Steel A216-WCB | SS A351-CF8M |

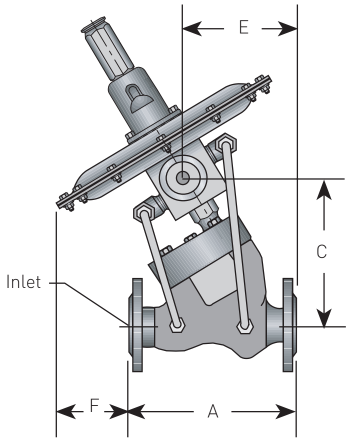
**NOTES**

1. NBR standard; FKM, EPR, Kalrez® optional. Kalrez® not available for Item 14.
2. Chrome plated.

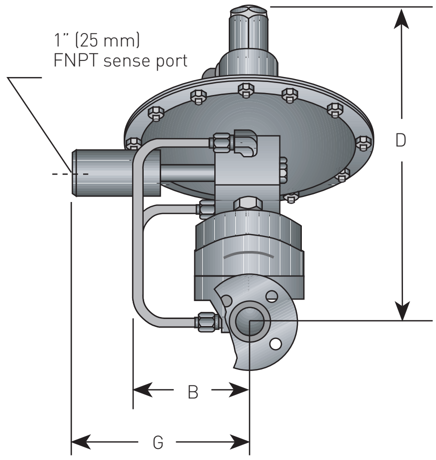
**RA (½-inch NPT)**




**Y1**




**Y1**



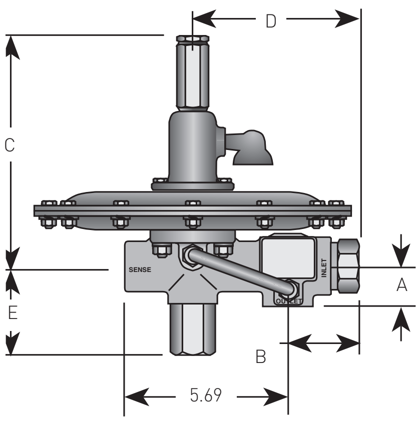

**DIMENSIONS, INCHES (mm) AND WEIGHTS, LB (kg)**

| Model | Size | Dimensions: A threaded ends | A flanges[1]: 150# | 300# | 600# | Maximum: B | C | D | E | F | G | Weight total | Pilot and cap |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y1 | 1" | 6.75 | 7.25 | 7.75 | 8.25 | 5.00 | 7.38 | 14.50 | 5.63 | 3.65 | 7.13 | 39 | 21 |
| | (25) | (171) | (184) | (197) | (210) | (127) | (187) | (368) | (143) | (93) | (181) | (17.69) | (9.52) |
| Y1 | 2" | 9.19 | 14.37 | 14.87 | 15.62 | 5.25 | 10.00 | 17.00 | 9.75 | 2.75 | 7.13 | 75 | 27 |
| | (50) | (233) | (365) | (378) | (397) | (133) | (254) | (432) | (248) | (70) | (181) | (34.0) | (12.3) |

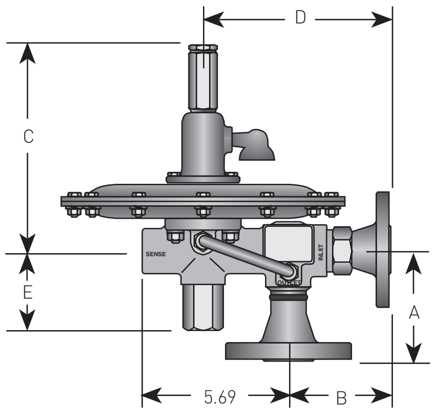
**NOTE**

1. Contact your sales representative for other flange configurations.

**BV-1 (1" NPT)**




**BV-1 (1" flanged)**




**DIMENSIONS, INCHES (mm) AND WEIGHTS, LB (kg)**

| Connection | A | B | C | D | E | Weight |
|---|---|---|---|---|---|---|
| Threaded | 1.91 (44) | 2.53 (64) | 8.25 (210) | 5.84 (148) | 3.25 (83) | 18.5 (8.4) |
| 150# flange | 4.06 (103) | 4.06 (103) | 8.25 (210) | 7.37 (187) | 3.25 (83) | 23.5 (10.7) |
| 300# flange | 4.31 (109) | 4.31 (109) | 8.25 (210) | 7.62 (193) | 3.25 (83) | 26.5 (12.0) |

Dimensions are ±.06 (±1.5 mm), unless noted otherwise. For other configurations, contact your sales representative.

## PRESSURE/TEMPERATURE RANGE

| Set pressure[1] | | | |
|---|---|---|---|
| ½" wc to 1.4" wc | (1.2 to 3.5 mbarg) | 0.6 to 1.4 psig | (41 to 97 mbarg) |
| 1.2" wc to 4" wc | (3.0 to 10.0 mbarg) | 1.3 to 3.1 psig | (90 to 215 mbarg) |
| 3.5" wc to 10" wc | (8.7 to 25 mbarg) | 2.3 to 3.5 psig | (160 to 241 mbarg) |
| 8" wc to 18" wc | (20 to 45 mbarg) | 3.0 to 6.0 psig | (207 to 414 mbarg) |
| 15" wc to 29" wc | (37 to 72 mbarg) | | |

**Minimum inlet pressure**

| | |
|---|---|
| RA: | No minimum |
| BV-1: | 15 psig (1.03 barg) |
| Y1: | 30 psig (2.07 barg) |

**Maximum pressure at sense port[2]**

15 psig (1.03 barg)

**Temperature[3]**

-20°F to 300°F (-29°C to 149°C)

**NOTES**

1. For higher set pressures than those published, contact your sales representative.
2. High strength cases available to 280 psig (19.3 barg).
3. For lower temperatures than those published, contact your sales representative.

## PERFORMANCE CHARACTERISTICS

Set pressure is defined as the point at which the valve begins to flow. As the demand for flow increases, the tank pressure must drop in order for the valve to respond, since a differential pressure is required to create the necessary forces to operate the valve.

This drop in tank pressure is called 'droop'. When the valve is 100% open, the tank pressure must increase for the valve to respond and close.

The difference between start to open and close is called 'deadband'. For the Type Y1 blanketing valve, this deadband is 1" wc (2.5 mbarg) at the lowest set pressure. For the Type BV-1 blanketing valve, it is ¾" wc (1.9 mbarg). Lockup, the rise above set pressure for total closure, is less than 0.1" wc (0.25 mbarg).

**Elastomer selection**

For diaphragms, seats and seals, it is important to specify an elastomer that is compatible with both the supply gas and the product being stored in the tank, as vapors will enter the valve from the discharge port and sense line. The RA and Y1 valves come with NBR soft goods as standard. The BV1 comes standard with Fluorosilicone and FKM seat and seals and a PTFE diaphragm. It is available with an internal purge which sweeps a small flow rate of blanket gas back through the sense port and tank connection.

**NACE trim**

Pilot and main valve trims are available for sour gas service in accordance with the latest edition of NACE MR0175.

**GOX/LOX**

The BV-1 model can be cleaned for GOX and LOX applications.

## SIZING

When sizing for tank blanketing, it is imperative to consider both:

a. blanketing gas replacement for liquid loss during pump-out
b. the condensation/contraction of tank vapors during atmospheric thermal cooling.

The required amount of blanketing gas and correct size of valve must be determined on the basis that both conditions could occur simultaneously.

The maximum flow rate through the blanketing valve will determine the size of relief valve. If a flow rate less than that listed in table C is required, restricted nozzles are available to limit the flow to 70, 50, 30 or 10% of the 100% rated capacity. Where applicable, the use of restricted nozzles will minimize the size of safety relief valve required. The BV-1 is also available with a 110% piston for increased capacity.

**To size a blanketing valve**

1. Determine the gas flow rate due to pump-out (from Table A).
2. Determine the gas flow rate due to atmospheric thermal cooling (from Table B).
3. Add the requirements of 1 and 2 and select valve size based on air capacity (from Table C).

**Excerpt from API 2000[1]**

For tanks with a capacity of 20 000 bbl or more, the requirements for the vacuum condition are very close to the theoretically computed value of 2 SCFH of air, per square foot of total shell and roof area.

For tanks with a capacity of less than 20 000 bbl, the requirements for the vacuum condition have been based on 1 SCFH of air for each barrel of tank capacity. Substantially, this is equivalent to a 100°F (38°C) per hour mean rate of vapor space temperature change (see Table B).

**NOTE**

1. API 2000, Section 2.4, Table 2.

## GAS FORMULA

**VALUES $C_2$ AND G**

| Gas | $C_2$ | G |
|---|---|---|
| Air | 1.00 | 1.00 |
| Natural gas | 0.98 | 0.60 |
| Nitrogen | 1.00 | 0.97 |

**English units**

$$V = 907\ C_2\ C_V\ P_1 \sqrt{\frac{X}{GT}}$$

**Metric units**

$$V = 263\ C_2\ C_V\ P_1 \sqrt{\frac{X}{GT}}$$

**$C_V$ VALVE SIZING COEFFICIENTS**

| Valve size | Nozzle size | $C_v$ |
|---|---|---|
| RA: ½" (15 mm) | No options | 0.385 |
| BV-1: 1" (25 mm) | 110% | 14.5 |
| BV-1: 1" (25 mm) | 100% | 13.2 |
| BV-1: 1" (25 mm) | 70% | 9.2 |
| BV-1: 1" (25 mm) | 50% | 6.6 |
| BV-1: 1" (25 mm) | 30% | 4.0 |
| BV-1: 1" (25 mm) | 20% | 2.6 |
| BV-1: 1" (25 mm) | 10% | 1.3 |
| BV-1: 1" (25 mm) | 5% | 0.7 |
| Y1: 1" (25 mm) | 100% | 10.0 |
| Y1: 1" (25 mm) | 70% | 7.0 |
| Y1: 1" (25 mm) | 50% | 5.0 |
| Y1: 1" (25 mm) | 30% | 3.0 |
| Y1: 2" (50 mm) | 100% | 43.6 |
| Y1: 2" (50 mm) | 70% | 30.5 |
| Y1: 2" (50 mm) | 50% | 21.8 |
| Y1: 2" (50 mm) | 30% | 13.1 |
| Y1: 2" (50 mm) | 10% | 4.4 |

**NOMENCLATURE**

| Symbol | Description | English units | Metric units |
|---|---|---|---|
| V | Required capacity | SCFM | $Nm^3/hr$ |
| $C_2$ | Correction factor for specific heat ratio | - | - |
| $C_v$ | Valve sizing coefficient | - | - |
| $P_1$ | Supply pressure at valve | psia | bara |
| X | 0.66 for $P_1 \leq$<br>0.69 for $P_1 >$ | 47.7 psia | 3.288 bara |
| G | Specific gravity | - | - |
| T | Relieving temperature | °R (°F + 460) | °K (°C + 273) |

### TABLE A (English) - in breathing rate due to pump-out

| Multiply maximum pump-out rate in: | By | To obtain |
|---|---|---|
| U.S. GPM | 8.021 | SCFH air required |
| U.S. GPH | 0.134 | SCFH air required |
| Barrels/hr | 5.615 | SCFH air required |
| Barrels/day | 0.234 | SCFH air required |
| Liters/min | 2.118 | SCFH air required |
| $m^3$/hr | 35.300 | SCFH air required |

### TABLE A (Metric) - in breathing rate due to pump-out

| Multiply maximum pump-out rate in: | By | To obtain |
|---|---|---|
| U.S. GPM | 0.215 | $Nm^3$/hr air required |
| IMP GPM | 0.258 | $Nm^3$/hr air required |
| Barrels/hr | 0.151 | $Nm^3$/hr air required |
| Barrels/day | 0.0063 | $Nm^3$/hr air required |
| Liters/min | 0.057 | $Nm^3$/hr air required |

### TABLE B[1] - in breathing rate due to thermal cooling

| | Tank capacity | | In breathing air | |
|---|---|---|---|---|
| Required barrels | Gallons | ($m^3$) | SCFH | ($Nm^3$/hr) |
| 60 | 2500 | (9.5) | 60 | (1.6) |
| 100 | 4200 | (15.9) | 100 | (2.7) |
| 500 | 21 000 | (79.5) | 500 | (13.4) |
| 1000 | 42 000 | (159) | 1000 | (26.8) |
| 2000 | 84 000 | (318) | 2000 | (53.6) |
| 3000 | 126 000 | (477) | 3000 | (80.4) |
| 4000 | 168 000 | (636) | 4000 | (107.2) |
| 5000 | 210 000 | (795) | 5000 | (134) |
| 10 000 | 420 000 | (1590) | 10 000 | (268) |
| 15 000 | 630 000 | (2385) | 15 000 | (402) |
| 20 000 | 840 000 | (3180) | 20 000 | (536) |
| 25 000 | 1 050 000 | (3975) | 24 000 | (643) |
| 30 000 | 1 260 000 | (4770) | 28 000 | (750) |
| 35 000 | 1,470 000 | (5560) | 31 000 | (830) |
| 40 000 | 1 680 000 | (6360) | 34 000 | (911) |
| 45 000 | 1 890 000 | (7150) | 37 000 | (992) |
| 50 000 | 2 100 000 | (7950) | 40 000 | (1070) |
| 60 000 | 2 520 000 | (9540) | 44 000 | (1180) |
| 70 000 | 2 940 000 | (11130) | 48 000 | (1290) |
| 80 000 | 3 360 000 | (12700) | 52 000 | (1400) |
| 90 000 | 3 780 000 | (14300) | 56 000 | (1500) |
| 100 000 | 4 200 000 | (15900) | 60 000 | (1600) |
| 120 000 | 5 040 000 | (19100) | 68 000 | (1800) |
| 140 000 | 5 880 000 | (22300) | 75 000 | (2000) |
| 160 000 | 6 720 000 | (25400) | 82 000 | (2200) |
| 180 000 | 7 560 000 | (28600) | 90 000 | (2400) |

**NOTE**

1. API 2000, Section 2.4, Table 2.

**TABLE C (English) - Flow capacities in SCFH** at **60°F[1] gas temperature, 100% nozzle**

| | | Type RA, ½" | | | BV-1, 1" | | | Y1, 1" | | | Y1, 2" | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Inlet pressure (psig)** | **Outlet press.*** | **Natural gas** | **Nitrogen** | **Air** | **Natural gas** | **Nitrogen** | **Air** | **Natural gas** | **Nitrogen** | **Air** | **Natural gas** | **Nitrogen** | **Air** |
| 15 | | 468 | 375 | 369 | 16027 | 12862 | 12688 | - | - | - | - | - | - |
| 20 | | 547 | 439 | 432 | 18725 | 15028 | 14801 | - | - | - | - | - | - |
| 25 | | 625 | 502 | 494 | 21424 | 17193 | 16933 | - | - | - | - | - | - |
| 30 | | 704 | 565 | 556 | 24122 | 19359 | 19066 | 18274 | 14666 | 14444 | 79675 | 63942 | 62975 |
| 40 | | 880 | 706 | 696 | 30182 | 24222 | 23856 | 22865 | 18350 | 18072 | 99691 | 80005 | 78796 |
| 50 | | 1042 | 835 | 823 | 35699 | 28650 | 28217 | 27045 | 21704 | 21376 | 117916 | 94631 | 93201 |
| 60 | | 1203 | 966 | 951 | 41217 | 33078 | 32578 | 31225 | 25059 | 24680 | 136141 | 109258 | 107606 |
| 70 | | 1363 | 1095 | 1078 | 46735 | 37506 | 36939 | 35405 | 28414 | 27984 | 154366 | 123884 | 122011 |
| 80 | | 1525 | 1224 | 1205 | 52252 | 41934 | 41300 | 39585 | 31768 | 31288 | 172591 | 138510 | 136416 |
| 90 | | 1685 | 1353 | 1333 | 57770 | 46362 | 45662 | 43765 | 35123 | 34592 | 190816 | 153136 | 150822 |
| 100 | | 1847 | 1482 | 1460 | 63288 | 50790 | 50023 | 47945 | 38478 | 37896 | 209041 | 167762 | 165227 |
| 110 | | 2008 | 1611 | 1587 | 68805 | 55219 | 54384 | 52125 | 41832 | 41200 | 227266 | 182388 | 179632 |
| 120 | | 2168 | 1740 | 1713 | 74323 | 59647 | 58745 | 56305 | 45187 | 44504 | 245491 | 197015 | 194037 |
| 130 | | 2330 | 1870 | 1841 | 79840 | 64075 | 63106 | 60485 | 48541 | 47808 | 263715 | 211641 | 208442 |
| 140 | | 2490 | 1999 | 1968 | 85358 | 68503 | 67467 | 64665 | 51896 | 51112 | 281940 | 226267 | 222847 |
| 150 | | 2651 | 2128 | 2095 | 90876 | 72931 | 71829 | 68845 | 55251 | 54416 | 300165 | 240893 | 237252 |
| 160 | | 2813 | 2257 | 2223 | 96393 | 77359 | 76190 | 73025 | 58605 | 57720 | 318390 | 255519 | 251657 |
| 170 | | 2973 | 2386 | 2350 | 101911 | 81787 | 80551 | 77205 | 61960 | 61023 | 336615 | 270145 | 266062 |
| 180 | | 3135 | 2515 | 2477 | 107429 | 86215 | 84912 | 81385 | 65315 | 64327 | 354840 | 284772 | 280468 |
| 190 | | 3296 | 2644 | 2605 | 112946 | 90643 | 89273 | 85565 | 68669 | 67631 | 373065 | 299398 | 294873 |
| 200 | | 3456 | 2773 | 2732 | 118464 | 95071 | 93635 | 89745 | 72024 | 70935 | 391290 | 314024 | 309278 |

* 1 psig or less

**TABLE D - CORRECTION FACTORS**

| Actual temperature °F | Correction factor |
|---|---|
| -20 | 1.0870 |
| 0 | 1.0630 |
| 20 | 1.0410 |
| 40 | 1.0200 |
| 60 | 1.0000 |
| 80 | 0.9813 |
| 100 | 0.9636 |
| 120 | 0.9469 |
| 150 | 0.9233 |
| 200 | 0.8876 |
| 250 | 0.8558 |

**NOTE**

1. To obtain capacities at a temperature other than 60°F, multiply capacity in Table C by appropriate temperature correction factor in Table D.

**TABLE C (metric) - Flow capacities in Nm³/hr at 0°C[1] gas temperature, 100% nozzle**

| | | Type RA, ½" (15 mm) | | | BV-1, 1" (25 mm) | | | Y1, 1" (25 mm) | | | Y1, 2" (50 mm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet pressure (barg) | Outlet press.* | Natural gas | Nitrogen | Air | Natural gas | Nitrogen | Air | Natural gas | Nitrogen | Air | Natural gas | Nitrogen | Air |
| 1.0 | | 13 | 10 | 10 | 435 | 349 | 344 | - | - | - | - | - | - |
| 2.0 | | 19 | 15 | 15 | 651 | 522 | 514 | 493 | 396 | 390 | - | - | - |
| 3.0 | | 26 | 21 | 20 | 886 | 711 | 700 | 671 | 539 | 531 | 2927 | 2349 | 2313 |
| 4.0 | | 32 | 26 | 26 | 1107 | 888 | 875 | 839 | 673 | 663 | 3656 | 2934 | 2890 |
| 5.0 | | 39 | 31 | 31 | 1328 | 1066 | 1049 | 1006 | 807 | 795 | 4386 | 3520 | 3466 |
| 6.0 | | 45 | 36 | 36 | 1549 | 1243 | 1224 | 1173 | 941 | 927 | 5115 | 4105 | 4043 |
| 7.0 | | 52 | 41 | 41 | 1769 | 1420 | 1399 | 1340 | 1076 | 1059 | 5844 | 4690 | 4619 |
| 8.0 | | 58 | 47 | 46 | 1990 | 1597 | 1573 | 1508 | 1210 | 1192 | 6574 | 5276 | 5196 |
| 9.0 | | 64 | 52 | 51 | 2211 | 1774 | 1748 | 1675 | 1344 | 1324 | 7303 | 5861 | 5772 |
| 10.0 | | 71 | 57 | 56 | 2432 | 1952 | 1922 | 1842 | 1478 | 1456 | 8032 | 6446 | 6349 |
| 11.0 | | 77 | 62 | 61 | 2653 | 2129 | 2097 | 2010 | 1613 | 1588 | 8762 | 7032 | 6925 |
| 12.0 | | 84 | 67 | 66 | 2873 | 2306 | 2271 | 2177 | 1747 | 1721 | 9491 | 7617 | 7502 |
| 13.0 | | 90 | 72 | 71 | 3094 | 2483 | 2446 | 2344 | 1881 | 1853 | 10220 | 8202 | 8078 |
| 14.0 | | 97 | 78 | 76 | 3315 | 2660 | 2620 | 2511 | 2015 | 1985 | 10950 | 8788 | 8655 |

* 70 mbarg or less

**TABLE D - CORRECTION FACTORS**

| Actual temperature (°C) | Correction factor |
|---|---|
| (-30) | 1.060 |
| (-20) | 1.039 |
| (-10) | 1.019 |
| (0) | 1.000 |
| (10) | 0.982 |
| (20) | 0.965 |
| (30) | 0.949 |
| (40) | 0.934 |
| (50) | 0.919 |
| (100) | 0.855 |
| (150) | 0.803 |

**NOTE**

1. To obtain capacities at a temperature other than 0°C, multiply capacity in Table C by appropriate temperature correction factor in Table D.

## SELECTION GUIDE

| Example: | Y1R | 2 | 1 | 5 | C | 1 | B | 1 | Y |
|---|---|---|---|---|---|---|---|---|---|

**Basic valve type**

| | |
|---|---|
| **BV** | Right angle style - pilot operated |
| **Y1R** | Y style - pilot operated |
| **RAR** | Direct spring |

**Valve size**

| | |
|---|---|
| **1** | 1" (25 mm) (BV-1 or Y1) |
| **2** | 2" (50 mm) (Y1 only) |
| **5** | ½" (15 mm) FNPT (RA only) |

**Connections**

| | | | |
|---|---|---|---|
| **S** | Threaded (internal NPT) | **L** | PN 6 |
| **1** | 150# | **M** | PN 10/16 |
| **3** | 300# | **N** | PN 25/40 |

**Nozzle/piston**[1]

| | | | | | |
|---|---|---|---|---|---|
| **1** | 100 percent | **3** | 30 percent | **x** | 5 percent (BV-1 only) |
| **7** | 70 percent | **2** | 20 percent (BV-1 only) | **0** | 110 percent (BV-1 only) |
| **5** | 50 percent | **9** | 10 percent | | |

**Body material**

| | |
|---|---|
| **C** | CS (RA and Y1 only) |
| **S** | 316 SS |
| **N** | CS/NACE (All SS in BV-1, RA models) |

**Main valve trim material**

| | |
|---|---|
| **1** | Standard trim |
| **2** | 316 SS trim (RA, BV-1 standard) |

**Seat, seal, and diaphragm material**

| | |
|---|---|
| **B** | NBR (RA, Y1 standard) |
| **V** | FKM |
| **E** | EPR |
| **X** | Other (specify) |
| **F** | Fluorosilicone with PTFE pilot diaphragm (standard for BV-1 model only) |

**Set pressure range**

| | | | |
|---|---|---|---|
| **1** | ½" wc to 1.4" wc (1.2 to 3.5 mbarg) | **6** | 0.6 psig to 1.4 psig (41 to 97 mbarg) |
| **2** | 1.2" wc to 4" wc (3.0 to 10.0 mbarg) | **7** | 1.3 psig to 3.1 psig (90 to 215 mbarg) |
| **3** | 3.5" wc to 10" wc (8.7 to 25 mbarg) | **8** | 2.3 psig to 3.5 psig (160 to 240 mbarg) |
| **4** | 8" wc to 18" wc (20 to 45 mbarg) | **9** | 3.0 psig to 6.0 psig (0.2 to 0.41 mbarg) |
| **5** | 15" wc to 29" wc (37 to 72 mbarg) | | |

**Options**

| | |
|---|---|
| **Y** | Pilot filter (available Y1 only) |
| **N** | No options |
| **E** | External purge meter |
| **P** | Internal purge (available BV-1 only) |
| **S** | Sense line control gauge |
| **T** | System pressure gauge |
| **D** | Both - sense line gauge and tank pressure gauge |

For special requirements contact your sales representative.

**NOTE**

1. RA is always 100 percent.